**Topic: Introduction to Estuaries** “A Day in the Life of an Estuary” – A simulation game.

**Description:**

Second to the air we breathe, water is an important resource which is taken for granted, especially by young people. Yet estuaries are among the most productive ecosystems but endangered ecosystems on the planet. The video will highlight the interconnectedness of estuaries and oceans and the simulations will sensitize students of the dangers faced through natural and human disruptions to the ecosystem. Letters to the editor and simulations will help students to take personal ownership of this problem and sensitize them of need to promote wise use of this resource

**Grade Levels: 8 – 10**

**Time: 90 minutes**

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| **Content Objective: SWBAT –**  Explain the need to manage estuaries wisely to sustain their economic, aesthetic, recreational and ecological resources.  **Skills Objective – SWBAT** Simulate actions that can change estuaries in both positive and negative ways.  Create letters/reports to explain the value of estuaries to the environment as well as our own well-being.  ***Standards addressed:*** HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.  HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.  **Competencies: 3C** | |
| ***Instructional Strategies:***  Comparing/Summarizing/note taking  Reinforcement/responding to student | **5.** Think-pair-share/Cooperative learning  6. Systems analysis/ Generating inquiry  7. cues and questions |
| ***Motivation***: **One Ocean Many Estuaries**. C**an one person make a difference?**  Estuaries are places where the fresh water from rain, creeks, and rivers meets with the salty water from the ocean. This place is special for many animals. The shallow estuary water has saltmarsh areas that are nurseries for many young animals like fish, shrimp, and crabs. Pollution from people’s activities ends up in the estuary too. Sometimes pollution in the rivers makes tiny water plants, or algae, grow, and too much can grow sometimes. These algae use up the oxygen in the water. Like us, fish need oxygen to breath. When there is not enough oxygen there can be a “fish kill.” During a fish kill, many fish are found dead in the water. Good things happen, too. People can clean up the waterways, set aside habitat for wildlife, and make sure they only to catch fish when they are big enough and plentiful enough to catch.” | |
| ***Materials/resources:*** Goldfish crackers or other similar game markers (bingo chips), paper bowls or blue construction paper, game card sets (one per team).  <http://estuaries.noaa.gov/teachers/estuaries.aspx> video  [**http://njseagrant.org/wp-content/uploads/2014/03/IntroductiontoEstuaries.pdf**](http://njseagrant.org/wp-content/uploads/2014/03/IntroductiontoEstuaries.pdf)  [**http://www.harborestuary.org/pdf/teachersguide.pdf**](http://www.harborestuary.org/pdf/teachersguide.pdf)  [**https://district79-public.rubiconatlas.org/Atlas/Browse/View/Map?BackLink=20798&CurriculumMapID=163&YearID=2015&SourceSiteID**](https://district79-public.rubiconatlas.org/Atlas/Browse/View/Map?BackLink=20798&CurriculumMapID=163&YearID=2015&SourceSiteID)**=** | |
| ***Aim:* How are estuaries important?** | ***Vocabulary:* estuary, ecosystem, habitat, biodiversity, aquatic, effluent, nutrients, eutrophication** |
| ***Whole class Information/Questions/Activities*:**  What are estuaries?  What are some types of estuaries?  How are estuaries interconnected with the world ocean?  How are estuaries important?  How are estuaries affected negatively?  What are some things that effect estuaries in good ways?  What kinds of things can we do to help preserve and protect estuaries?  Did your population completely die off? Why? Why not?  Do you think that in real life this would happen? Why or why not? | ***Expected Student Responses*:**  These are transition zones between land and sea, fresh and salt water  Coastal, tectonic, fjords  An estuary is an arm of the sea that extends inland to the mouth  Estuaries are among the most productive of Earth’s ecosystems  human and natural causes : By disruption of food webs – loss of species  Answers will vary  Answers will vary  Answers will vary  Answers will vary |
| ***Whole Class Activity***  ***Introduction students will***  Review vocabulary  View a video clip on ‘What’s an estuary”.  Write 2 important details form the video then share with a partner. Class discussion  “***Development:* Students will be:**  1.Placed in groups of four, with one student designated as the “fish” banker and card holder  **be assigned a** blue bowl (the estuary) with 10 gold fish crackers, one set of game cards and goldfish crackers  Each student will draw a card and add or subtract “fish” as directed. Game continues until all cards have been drawn or each team’s “estuary” is depleted of “fish.” | ***Differentiation:***  **a.** Chart changes in the ecosystem based on the simulation  b. Write a letter to the editor explaining three problems in the estuary. Make one recommendation that will reverse this problem?  c. Document the changes in an estuary from the point of view of a fish  **Share-aloud:** Students will read responses to the class  ***Conclusion:*** Students will discuss how this estuary may be affected in real-life  ***Homework:* Students will**  Research the names and locations of 4 estuaries in New York .  Describe 3 problems facing the Hudson Estuary. Create a plan to solve one problem |
| ***Monitoring and Assessment:* Observations/review of work/presentations** | ***Rubric***  ***maximum Average minimum***  ***Class Discussion 10 6 2***  ***Activities completed 10 6 2***  ***Written Responses 10 6 2*** |

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| **Bluefish closes in on school of smaller fish.**  **Take out 3 fish.** |  | **Mr. Farmer sprayed for insects in his field on the edge of the waterway. When it rained, the runoff killed 3 fish.**  **Take out 3 fish** |
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| **Legal protection for your fish species.**  **Add 5 fish.** |  | **Volunteers do a “Clean Sweep” along the estuary.**  **No fish lost** |
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| **Ms. Farmer fertilized her bean crop. Extra algae grew in the water. Fish die.**  **Take out 2 fish.** |  | **The nursery has lost 3 fry. (fish babies)**  **Take out 3 fish.** |
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| **3 fish are caught in a gill net set by Ms. Jones.**  **Take out 3 fish.** |  | **Salt marsh area set aside as nature reserve.**  **Add 4 fish.** |
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| **Seals feed in the estuary.**  **Lose 2 fish.** |  | **New marina attracts 20 new boats to stay in the estuary.**  **Lose 3 fish.** |
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| **Great weather increases habitat.**  **Add 2 fish** |  | **A boater dropped a can of oil in the water and 3 fish died.**  **Take out 3 fish.** |
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| **A seagull flies over. It eats a fish for dinner.**  **Take out 1 fish.** |  | **Salt marsh left undisturbed.**  **Each player gets to add 4 baby fish.** |
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| **Something mysterious in the water kills fish.**  **Take out 8 fish.** |  | **New fry hatch.**  **Add 5 fish.** |
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| **A vacationing family went fishing. Mr. and Mrs. Jones, little Jim and Judy each caught a fish. How many fish will you take out?** |  | **Area becomes protected for wildlife, fishing is prohibited.**  **Add 3 fish.** |
| **A shark ate 3 fish** |  | **Someone builds a new dock without a permit. 2 fish are killed when pilings hurt their habitat.**  **Take out 2 fish.** |
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| **Big algae bloom due to over fertilization of golf course nearby. No oxygen left.**  **Take out 10 fish** |  | **A fish ate a rubber worm Mr. Jones lost while fishing, the fish dies.**  **Take out 1 fish.** |
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| **Artificial reef installed.**  **Add 4 fish.** |  | **Fish ate a piece of plastic trash and dies.**  **Take out 1 fish** |